

**Claims**

We claim:

1. A sternal closure device for joining first and second portions of a severed sternum, each portion having exposed cortical and cancellous surfaces at a sternal incision margin, the device comprising: at least one first bearing member; at least one second bearing member; at least one sternum joining member engaging the first and second bearing members, and the at least one sternum joining member adapted to traverse the exposed cancellous surfaces at the sternal incision margins of the first and second sternal portions.  
5
2. The device of claim 1, wherein the sternum joining member is comprised of an axis, a first end, and a second end; the first end connected to the first bearing member; the second bearing member adapted to engage the second end of the sternum joining member.  
10
3. The device of claim 1, wherein the sternum joining member is comprised of first and second ends that engage the second bearing member.  
15
4. The device of claim 1, where the sternum joining member is arcuate.  
20
5. The device of claim 1, comprising a plurality of sternum joining members connected to a plurality of first bearing members that are connected via a flexible member.

6. The device of claim 1, wherein at least one first bearing member or second bearing member is comprised of a sternum contacting surface, a protrusion having a first end and a second end, the first end of the protrusion attached to the sternum contacting surface, the second end of the protrusion engaged with the sternum joining member.
7. The device of claim 1, wherein the first bearing member or second bearing member is a toggle or expandable anchor.
8. The device of claim 1, further comprising securing means.
9. The device of claim 8, wherein the securing means is selected from the group consisting of a ratcheted surface in combination with a counter ratcheting surface, a wedge lock, a non-reversing cinch loop, a barbed surface and a perforated surface.
10. The device of claim 1, wherein the first bearing member, second bearing member, or sternum joining member are comprised of a material selected from the group consisting of stainless steel, titanium, shape memory alloys, superelastic alloys, and polymers.
11. The device of claim 10, wherein the polymer is selected from the group consisting of polyethylene, ultra high molecular weight polyethylene, polypropylene, polytetrafluoroethylene, nylon, polylactide, polygalactide, and copolymers of polymer lactide and polygalactide.

12. The device of claim 10, wherein the superelastic alloy or shape memory alloy is nitinol.
13. The device of claim 1, wherein the first bearing member, second bearing member or sternum joining member is coated with a material containing at least one therapeutic agent.
14. The device of claim 13, wherein the therapeutic agent is selected from the group consisting of antibiotics, analgesics, anesthetics, hydroxyapatite, hemostatic agents, and osteogenic factors.
15. A method for closing a severed sternum having first and second portions that are formed after a sternal incision has been made perpendicular to the plane of the anterior or posterior surface of the sternum, each portion having exposed cortical and cancellous surfaces at the sternal incision margin, comprising: placing at least one first hole in the first sternal portion and at least one second hole in the second sternal portion, such that the first and second holes form a pathway from the anterior surface to the posterior surface of the sternum, the pathway obliquely traversing the sternal incision margins when the first and second sternal portions are approximated; at least partially approximating the first and second sternal portions, and performing one of the following steps (a)-(d):

(a) providing a device comprising a first bearing member having a collapsed and an expanded position, a second

bearing member, and a sternum joining member having an axis and engaging the first and second bearing members; inserting the first bearing member through the pathway with the first bearing member in a collapsed position, until the first bearing member extends past the posterior surface of the sternum and assumes the expanded position; moving the second bearing member along the axis of the sternum joining member until the first and second sternal portions are approximated; and securing the sternum joining member to the second bearing member; or

(b) providing a device comprising a first bearing member having a collapsed and an expanded position, and a sternum joining member engaging the first bearing member and having an axis and a free end, inserting the first bearing member through the pathway with the first bearing member in a collapsed position, until the first bearing member extends past the posterior surface of the sternum and assumes the expanded position; engaging a second bearing member with the free end of the sternum joining member; moving the second bearing member along the axis of the sternum joining member until the first and second sternal portions are approximated; and securing the sternum joining member to the second bearing member; or

(c) providing a device comprising a first bearing member,

and a sternum joining member engaging the first bearing member and having an axis and a free end; inserting the free end of the sternum joining member in the formed pathway from either the anterior or posterior surface of the sternum until the free end extends past the opposite surface of the sternum; engaging a second bearing member with the free end of the sternum joining member; moving the second bearing member along the axis of the sternum joining member until the first and second sternal portions are approximated; and securing the sternum joining member to the second bearing member; or

(d) inserting a sternal joining member having an axis and first and second ends, in the formed pathway until the ends extends past the anterior and posterior surfaces of the sternum; engaging a first bearing member with the first end and a second bearing member with the second end of the sternum joining member; moving the second bearing member along the axis the sternum joining member until the first and second sternal portions are approximated; and securing the sternum joining member to the second bearing member.

16. A method for closing a severed sternum having first and second portions that are formed after a sternal incision has been made perpendicular to the plane of the anterior or posterior surface of the sternum, each portion having exposed cortical and cancellous

surfaces at the sternal incision margin, comprising: placing at least one first hole in the first sternal portion and at least one second hole in the second sternal portion, such that the first and second holes form a pathway from one intercostal space in the first sternal portion to an opposite intercostal space in the second sternal portion, the pathway perpendicularly traversing the sternal incision margins when the first and second sternal portions are approximated; at least partially approximating the first and second sternal portions; and performing one of the following steps (a) or (b):

(a) providing a device comprising a first bearing member, and a sternum joining member engaging the first bearing member and having an axis and a free end; inserting the free end of the sternum joining member in the formed pathway from one intercostal space until the free end extends into the opposite intercostal space; engaging a second bearing member with the free end of the sternum joining member; moving the second bearing member along the axis of the sternum joining member until the first and second sternal portions are approximated; and securing the sternum joining member to the second bearing member; or

(b) inserting a sternal joining member having an axis and first and second ends, in the formed pathway from one intercostal space until the first and second ends extend into opposite intercostal spaces; engaging a first

bearing member with the first end and a second bearing member with the second end of the sternum joining member; moving the second bearing member along the axis of the sternum joining member until the first and second sternal portions are approximated; and securing the sternum joining member to the second bearing member.

5

10

17. A kit for surgically closing a severed sternum, the kit comprising; at least one of the sternal closure devices of claim 1, means for creating a hole in the sternum, a guide, and an introducer.

18. The kit of claim 17, wherein the means for creating the hole is selected from the group consisting of a bone punch, needle, trocar, and drill.

19. The kit of claim 18, further comprising a grasping device.

15

20. The device of claim 1, where the at least one sternum joining member obliquely or perpendicularly traverses the exposed cancellous surfaces at the sternal incision margins of the first and second sternal portions.